BEHAVIOUR OF GLAZING PANELS UNDER HIGH-INTENSITY, SHORT-DURATION BLAST LOADING

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The response of a glazing panel to high-intensity, short-duration loading, such as that from explosions, is analysed using an explicit dynamic finite element algorithm coded into a computer program. This specialised software allows for the simulation of monolithic, laminated and insulated glazing, and is capable of predicting glazing displacements and stresses up to cracking of the glass. To simulate the true behaviour of the glass panel, a variety of support conditions are available, including elastic supports, along with different methods of specifying the blast load. The software is also capable of predicting the hazard level associated with a particular combination of glazing and blast load. From a numerical modelling point of view, a pane of glass is meshed using four-noded, thick-plate elements that employ an equivalent single layer approach to simulate the behaviour of laminated glass, whereas the solution of the equations of dynamic equilibrium is achieved through an explicit version of the Newmark-Beta algorithm. Glass failure is defined using either a principal stress failure criterion or a probability-based glass failure prediction model. The latter incorporates all known factors affecting glass strength, including surface flaw size, distribution and orientation, as well as load duration and relative humidity, and has been adapted in the model to predict the probability of failure in a pane of glass subject to a dynamic load.

Details of the numerical algorithm, together with the verification procedure are followed by the exemplification of a parametric study. The latter has been performed to determine appropriate relationships between different glazing make-ups, having various dimensions and aspect ratios, and under different types of blast loadings. The effect of boundary conditions is also included, as are different parameters that define failure criteria for several types of glass materials. Data from these analyses are evaluated in an attempt to establish trends and simple relationships between the different parameters involved. This represents one important component of a research endeavour that aims to provide insight into the complex and under-researched behaviour of glazing panels subject to blast loading.